Energy-Efficient Replacement of Electric Resistance Water Heaters in Low-Rise Multifamily Buildings

Highlights

- Market size presents strong energy-efficiency savings opportunity.
- Currently, most existing electric resistance water heaters are replaced with another electric resistance water heater.
- Technical, market and economic barriers challenge multifamily heat pump water heater applications.
    - Heat pump water heaters are not the right size or shape for easy retrofit.
    - Consumers are not familiar with heat pump water heater products.
    - Heat pump water heaters have higher initial costs and benefits that accrue to tenants, in most cases.
- Several utilities offer rebates for multifamily heat pump water heater replacements. All had limited uptake.
- Need an affordable heat pump water heater configured for multifamily units to be successful.

Introduction

According to the 2016 Residential Building Stock Analysis, there are more than 744,000 units in low-rise multifamily buildings in the Pacific Northwest. Seventy percent of these dwellings have in-unit domestic hot water heaters and 87 percent of the water heaters are electric resistance. This represents a savings opportunity of more than 150 aMW if they could be replaced by heat pump water heaters (HPWH).

The Bonneville Power Administration and Pacific Northwest utilities would like to increase the uptake of HPWHs in this market and engaged the Washington State University Energy Program to conduct secondary research to help answer the following questions:

- What products are currently available as replacement options?
- Have other utilities had success in this market?
- What are the technical, economic, and other barriers to adoption?
- What steps can we take to address these barriers?

The information gathering included internet and publication searches, and interviews with industry experts, utilities and private-sector stakeholders. The study was limited to one-to-one replacement options for existing buildings with electric water heaters.

Replacement Options

In the Pacific Northwest, Energy Trust of Oregon and Puget Sound Energy have offered rebates for HPWH that meet Northwest Energy Efficiency Alliance cold climate specifications in multifamily applications. Both programs have experienced very little uptake.

Results of out-of-region utility interviews are summarized below. These utilities also reported low participation.

Utility	Measure
Sacramento Municipal Utility District	• $1,000 – $1,500 per unit replacing electric or gas to offset HPWH premium. • Up to quadplex residential.
Pacific Gas & Electric	• Part of a bundled incentive for modeled performance only.
Austin Energy	• $800 rebates for new HPWH retrofit. • ENERGY STAR® rated, energy factor of 2.0 or better, minimum size of 40 gallons, permanent installation.
Public Utility Company of New Mexico	• $155 for energy factor 2.0 and $215 for energy factor 3.5 or greater for new HWPW in retrofit application. • Must be labeled an ENERGY STAR HPWH.

Technical Issues

The two biggest technical barriers are size and location. Because HPWH are taller than most electric resistance water heaters, they may not fit in the same space. Venting is advised for HPWH to avoid interaction with the space conditioning. This is difficult to achieve unless the water heater closet is located next to an exterior wall; many existing electric resistance water heaters are located in interior closets.

To address these issues, BPA will collaborate with others, including the Northwest Energy Efficiency Alliance, the Electric Power Research Institute and California utilities to identify smaller HPWH that will fit existing closet space. This includes looking to Europe and Asia for products and working with U.S. manufacturers.

BPA will also continue to work to familiarize contractors with split-system HPWHs currently on the qualified product list. These avoid the need for venting and require only a small hole in the building envelope. The indoor tank is similar in size to existing electric resistance water heaters. A drawback to split systems is the need to locate the heat pump on an exterior wall. In the case of carbon dioxide HPWH, the capacity of one outdoor heat pump unit is usually sufficient to supply up to four indoor hot

water storage tanks, reducing exterior space requirements. Several demonstration projects using various configurations of a split-system CO_2 HPWH are currently underway.

Economic Barriers

The biggest economic barrier is the higher cost of HPWH. The starting price of a HPWH is approximately $1,600 compared to approximately $350 for an electric resistance heater. Installation costs are also higher since the product is not yet designed for plug-and-play in multifamily homes. In the multifamily market there is the additional barrier of a split incentive since lower operating costs typically benefit renters instead of owners, yet the owners fund the cost of the upgrade.

Options to overcome economic barriers may include:

- Develop a campaign to encourage or assist property owners and occupants to budget for water heater failures. Planning ahead is more likely to create opportunities for replacing a failed electric resistance water heater with a HPWH.
- Offer larger incentives for Tier 2 or Tier 3 HPWHs to overcome the price and unfamiliarity barriers.
- Encourage distributors to offer discounted products for bulk purchase.

Market Barriers

Market barriers to HPWH in multifamily are the same as for the whole residential sector, including:

- Consumers are unfamiliar with HPWH technology and its benefits. There also appears to be a lack of skilled installers and maintenance technicians who are familiar with the technology.
- Most water heaters are replaced when they fail, and owners select an easy and quick replacement. These are predominantly electric resistance water heaters in the absence of a plan and budget prepared ahead of time.
- Early poor performance resulted in a bad reputation for HPWH. Even though performance has greatly improved, that stigma continues to linger, especially with contractors and installers.

BPA will continue efforts to build awareness and to promote the benefits of HPWH. Marketing campaigns may attract renters who appreciate energy efficiency—especially millennials who are driving the market.

Looking Ahead

BPA is committed to pursuing solutions for this underserved, but high-potential market. If you have ideas to share or know of successful projects, we would love to hear from you. Please contact Robert Weber at rmweber@bpa.gov.